IDEAS IN CONTEXT

THE Taming OF Chance

THE TAMING OF CHANCE

IAN HACKING
Institute for the History and Philosophy of Science and Technology, University of Toronto

CAMBRIDGE UNIVERSITY PRESS

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK
40 West 20th Street, New York, NY 10011–4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia
Ruiz de Alarcón 13, 28014 Madrid, Spain
Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

First published 1990
Reprinted 1991, 1992, 1995, 1998, 1999, 2001, 2002

Printed in the United Kingdom at the University Press, Cambridge

British Library Cataloguing in Publication data
Hacking, Ian, *1936–*
The taming of chance. – (Ideas in context).
1. Probabilities – Philosophical perspectives
I. Title II. Series
121′.63

Library of Congress Cataloguing in Publication data
Hacking, Ian.
The taming of chance / Ian Hacking.
p. cm. – (Ideas in context)
ISBN 0-521-38014-6. – ISBN 0-521-38884-8 (pbk.)
1. Chance. 2. Necessity (Philosophy)
I. Title. II. Series.
SD595.H33 1990
123′.3–dc 89-36411 CIP

ISBN 0 521 38014 6 hard covers
ISBN 0 521 38884 8 paperback

CE

1

The argument

The most decisive conceptual event of twentieth century physics has been the discovery that the world is not deterministic. Causality, long the bastion of metaphysics, was toppled, or at least tilted: the past does not determine exactly what happens next. This event was preceded by a more gradual transformation. During the nineteenth century it became possible to see that the world might be regular and yet not subject to universal laws of nature. A space was cleared for chance.

This erosion of determinism made little immediate difference to anyone. Few were aware of it. Something else was pervasive and everybody came to know about it: the enumeration of people and their habits. Society became statistical. A new type of law came into being, analogous to the laws of nature, but pertaining to people. These new laws were expressed in terms of probability. They carried with them the connotations of normalcy and of deviations from the norm. The cardinal concept of the psychology of the Enlightenment had been, simply, human nature. By the end of the nineteenth century, it was being replaced by something different: normal people.

I argue that these two transformations are connected. Most of the events to be described took place in the social arena, not that of the natural sciences, but the consequences were momentous for both.

Throughout the Age of Reason, chance had been called the superstition of the vulgar. Chance, superstition, vulgarity, unreason were of one piece. The rational man, averting his eyes from such things, could cover chaos with a veil of inexorable laws. The world, it was said, might often look haphazard, but only because we do not know the inevitable workings of its inner springs. As for probabilities – whose mathematics was called the doctrine of chances – they were merely the defective but necessary tools of people who know too little.

There were plenty of sceptics about determinism in those days: those who needed room for freedom of the will, or those who insisted on the individual character of organic and living processes. None of these thought for a moment that laws of chance would provide an alternative to strictly causal laws. Yet by 1900 that was a real possibility, urged as fact by an

adventurous few. The stage was set for ultimate indeterminism. How did that happen?

This is not a question about some sort of decay in knowledge or management. The erosion of determinism is not the creation of disorder and ignorance – quite the contrary. In 1889 Francis Galton, founder of the biometric school of statistical research, not to mention eugenics, wrote that the chief law of probability 'reigns with serenity and in complete effacement amidst the wildest confusion'.[1] By the end of the century chance had attained the respectability of a Victorian valet, ready to be the loyal servant of the natural, biological and social sciences.

There is a seeming paradox: the more the indeterminism, the more the control. This is obvious in the physical sciences. Quantum physics takes for granted that nature is at bottom irreducibly stochastic. Precisely that discovery has immeasurably enhanced our ability to interfere with and alter the course of nature. A moment's reflection shows that a similar statement may be attempted in connection with people. The parallel was noticed quite early. Wilhelm Wundt, one of the founding fathers of quantitative psychology, wrote as early as 1862: 'It is statistics that first demonstrated that love follows psychological laws.'[2]

Such social and personal laws were to be a matter of probabilities, of chances. Statistical in nature, these laws were nonetheless inexorable; they could even be self-regulating. People are normal if they conform to the central tendency of such laws, while those at the extremes are pathological. Few of us fancy being pathological, so 'most of us' try to make ourselves normal, which in turn affects what is normal. Atoms have no such inclinations. The human sciences display a feedback effect not to be found in physics.

The transformations that I shall describe are closely connected with an event so all-embracing that we seldom pause to notice it: an avalanche of printed numbers. The nation-states classified, counted and tabulated their subjects anew. Enumerations in some form have been with us always, if only for the two chief purposes of government, namely taxation and military recruitment. Before the Napoleonic era most official counting had been kept privy to administrators. After it, a vast amount was printed and published.

The enthusiasm for numerical data is reflected by the United States census. The first American census asked four questions of each household. The tenth decennial census posed 13,010 questions on various schedules addressed to people, firms, farms, hospitals, churches and so forth. This 3,000-fold increase is striking, but vastly understates the rate of growth of printed numbers: 300,000 would be a better estimate.

The printing of numbers was a surface effect. Behind it lay new

technologies for classifying and enumerating, and new bureaucracies with the authority and continuity to deploy the technology. There is a sense in which many of the facts presented by the bureaucracies did not even exist ahead of time. Categories had to be invented into which people could conveniently fall in order to be counted. The systematic collection of data about people has affected not only the ways in which we conceive of a society, but also the ways in which we describe our neighbour. It has profoundly transformed what we choose to do, who we try to be, and what we think of ourselves. Marx read the minutiae of official statistics, the reports from the factory inspectorate and the like. One can ask: who had more effect on class consciousness, Marx or the authors of the official reports which created the classifications into which people came to recognize themselves? These are examples of questions about what I call 'making up people'. This book touches on them only indirectly.[3]

What has the avalanche of printed numbers to do with my chief topic, the erosion of determinism? One answer is immediate. Determinism was subverted by laws of chance. To believe there were such laws one needed law-like statistical regularities in large populations. How else could a civilization hooked on universal causality get the idea of some alternative kind of law of nature or social behaviour? Games of chance furnished initial illustrations of chance processes, as did birth and mortality data. Those became an object of mathematical scrutiny in the seventeenth century. Without them we would not have anything much like our modern idea of probability. But it is easy for the determinist to assume that the fall of a die or the spin of a roulette work out according to the simple and immutable laws of mechanics. Newtonian science had no need of probabilities, except as a tool for locating underlying causes. Statistical laws that look like brute, irreducible facts were first found in human affairs, but they could be noticed only after social phenomena had been enumerated, tabulated and made public. That role was well served by the avalanche of printed numbers at the start of the nineteenth century.

On closer inspection we find that not any numbers served the purpose. Most of the law-like regularities were first perceived in connection with deviancy: suicide, crime, vagrancy, madness, prostitution, disease. This fact is instructive. It is now common to speak of information and control as a neutral term embracing decision theory, operations research, risk analysis and the broader but less well specified domains of statistical inference. We shall find that the roots of the idea lie in the notion that one can improve – control – a deviant subpopulation by enumeration and classification.

We also find that routinely gathering numerical data was not enough to make statistical laws rise to the surface. The laws had in the beginning to be

read into the data. They were not simply read off them. Throughout this book I make a contrast of a rough and ready sort between Prussian (and other east European) attitudes to numerical data, and those that flourished in Britain, France, and other nations of western Europe. Statistical laws were found in social data in the West, where libertarian, individualistic and atomistic conceptions of the person and the state were rampant. This did not happen in the East, where collectivist and holistic attitudes were more prevalent. Thus the transformations that I describe are to be understood only within a larger context of what an individual is, and of what a society is.

I shall say very little about mathematical conceptions of probability. The events to be described are, nevertheless, ingredients for understanding probability and for grasping why it has been such an incredible success story. Success story? A quadruple success: metaphysical, epistemological, logical and ethical.

Metaphysics is the science of the ultimate states of the universe. There, the probabilities of quantum mechanics have displaced universal Cartesian causation.

Epistemology is the theory of knowledge and belief. Nowadays we use evidence, analyse data, design experiments and assess credibility in terms of probabilities.

Logic is the theory of inference and argument. For this purpose we use the deductive and often tautological unravelling of axioms provided by pure mathematics, but also, and for most practical affairs, we now employ – sometimes precisely, sometimes informally – the logic of statistical inference.

Ethics is in part the study of what to do. Probability cannot dictate values, but it now lies at the basis of all reasonable choice made by officials. No public decision, no risk analysis, no environmental impact, no military strategy can be conducted without decision theory couched in terms of probabilities. By covering opinion with a veneer of objectivity, we replace judgement by computation.

Probability is, then, *the* philosophical success story of the first half of the twentieth century. To speak of philosophical success will seem the exaggeration of a scholar. Turn then to the most worldly affairs. Probability and statistics crowd in upon us. The statistics of our pleasures and our vices are relentlessly tabulated. Sports, sex, drink, drugs, travel, sleep, friends – nothing escapes. There are more explicit statements of probabilities presented on American prime time television than explicit acts of violence (I'm counting the ads). Our public fears are endlessly debated in terms of probabilities: chances of meltdowns, cancers, muggings, earthquakes, nuclear winters, AIDS, global greenhouses, what next? There is

nothing to fear (it may seem) but the probabilities themselves. This obsession with the chances of danger, and with treatments for changing the odds, descends directly from the forgotten annals of nineteenth century information and control.

This imperialism of probabilities could occur only as the world itself became numerical. We have gained a fundamentally quantitative feel for nature, how it is and how it ought to be. This has happened in part for banal reasons. We have trained people to use numerals. The ability to process even quite small numbers was, until recently, the prerogative of a few. Today we hold numeracy to be at least as important as literacy.

But even compared with the numerate of old there have been remarkable changes. Galileo taught that God wrote the world in the language of mathematics. To learn to read this language we would have to measure as well as calculate. Yet measurement was long mostly confined to the classical sciences of astronomy, geometry, optics, music, plus the new mechanics. T.S. Kuhn has iconoclastically claimed that measurement did not play much of a role in the 'Baconian' sciences that came to be called chemistry and physics.[4] He urged that measurement found its place in physics – the study of light, sound, heat, electricity, energy, matter – during the nineteenth century. Only around 1840 did the practice of measurement become fully established. In due course measuring became the only experimental thing to do.

Measurement and positivism are close kin. Auguste Comte coined the word 'positivism' as the name of his philosophy, holding that in all the European languages the word 'positive' had good connotations. His own philosophy did not fare especially well, but the word caught on. Positive science meant numerical science. Nothing better typified a positive science than a statistical one – an irony, for Comte himself despised merely statistical inquiries.

The avalanche of numbers, the erosion of determinism, and the invention of normalcy are embedded in the grander topics of the Industrial Revolution. The acquisition of numbers by the populace, and the professional lust for precision in measurement, were driven by familiar themes of manufacture, mining, trade, health, railways, war, empire. Similarly the idea of a norm became codified in these domains. Just as the railways demanded timekeeping and the mass-produced pocket watch, they also mandated standards, not only of obvious things such as the gauge of the lines but also of the height of the buffers of successive cars in a train. It is a mere decision, in this book, to focus on the more narrow aspects that I have mentioned, a decision that is wilful but not arbitrary. My project is philosophical: to grasp the conditions that made possible our present organization of concepts in two domains. One is that of physical indeter-

everything. I leave out Malthus and Mendel, for example, A.A. Cournot, Gustav Fechner, Florence Nightingale and ever so many more modest participants in the taming of chance. Very well: but I say nothing of Maxwell, Bolzmann or Gibbs, although statistical mechanics is critical to the spread of chance and probability not only into physics but also into metaphysics. I say nothing of Charles Darwin, although evolutionary theorizing was to import chance into biology. I say nothing of Karl Marx fabricating an iron necessity out of the very same numerals, the identical official statistics, that I have incorporated into an account of the taming of chance.

There is an uncontroversial good reason for silence about these figures. Scholars and teams of scholars dedicate their lives to the study of one or another. It would be folly to venture a short story here, a mere chapter. But it is not only prudence and respect, but also method, that makes me hold my tongue. Transformations in concepts and in styles of reasoning are the product of countless trickles rather than the intervention of single individuals. Marx, Darwin and Maxwell worked in a space in which there was something to find out. That means: in which various possibilities for truth-or-falsehood could already be formulated. This book is about that space. So although a lot of sentences are reproduced in this book, they are the words not of heroes, but of the mildly distinguished in their day, the stuff of the more impersonal parts of our lives.

Sentences have two powers. They are eternal, and they are uttered at a moment. They are anonymous, and yet they are spoken by flesh and blood. I have tried to answer to these two facts. On the one hand, I do regard the sentences as mere material objects, inscriptions. But to do that, and only that, is to become lost in vain abstraction. As counterbalance, my epigraphs to each chapter are dated, to recall that on a real day important to the speaker, those very words were uttered, or are said to have been uttered. My footnotes (marked with asterisks) are anecdotes that would be improper in the more solemn text.* They give some tiny glimpse of who the speakers were. But there is seldom anything personal about the footnotes. They address the individual as official, as public writer, even if his behaviour may strike us, so much later, as strange.

Thus although many chapters have a central character or text, it is not because Salomon Neumann, A.-M. Guerry or John Finlaison is 'important'. They are convenient and exemplary anchors for a particular organization of sentences. I use the antistatistical method, that of Frédéric Le Play, topic of chapter 16. After having interminably trekked across the

* Notes at the end of the book provide references, and, rarely, numerical formulae. They are marked with numerals. A numeral after an asterisk (as *[3]) indicates that note 3 at the end of the book bears on the material in the footnote marked *.

written equivalent of his Hartz mountains, I take what I think is the best example of one speaker. Much like Le Play, I include a few stories, but the personages whom I use are in some ways like his household budgets, if, alas, less thorough.

There is one exception among these chapters. The final one is twice as long as the others, and is a rather full account of one side of one writer, namely C.S. Peirce. He really did believe in a universe of absolute irreducible chance. His words fittingly end this book, for as he wrote, that thought had become possible. But I argue that it became possible because Peirce now lived a life that was permeated with probability and statistics, so that his conception of chance was oddly inevitable. He had reached the twentieth century. I use Peirce as a philosophical witness in something like the way that I used Leibniz in *The Emergence of Probability*.[10] But Leibniz was a witness to the transformation that I was there describing, namely the emergence of probability around 1660 and just afterwards. Here Peirce is the witness to something that had already happened by the time that he was mature. That is why he is the topic of the last chapter, whereas in *Emergence* the name of Leibniz recurred throughout.

Although other philosophers are mentioned in the two books, only Leibniz and Peirce play a significant part. The two works do, however, differ in structure in other ways. *Emergence* is about a radical mutation that took place very quickly. Doubtless, as Sandy Zabell and Daniel Garber have shown in an exemplary way, the book underestimated various kinds of precursors.[11] My central claim was, however, that many of our philosophical conceptions of probability were formed by the nature of the transition from immediately preceding Renaissance conceptions. Accounts of the methodology have been given elsewhere.[12] *Taming*, in contrast is about a gradual change. Hence the geological metaphors: avalanches, yes, but also erosion.

Most of my selections and omissions – such as my long treatment of Peirce and my neglect of any other philosopher – have been deliberate. But sloth and good fortune have also played their part. When I began work there was hardly any recent secondary material; now there is a great deal. I am particularly glad of new books by my friends Lorraine Daston, Ted Porter and Stephen Stigler, and of earlier ones by William Coleman and Donald MacKenzie. We all participated in a collective inspired and guided by Lorenz Krüger. The joint work of that group has also appeared. Hence there is now a number of brilliant and often definitive accounts of many matters that overlap with mine.[13] They have made it unnecessary for me to examine a good many matters. And aside from specific histories, there are also points of great generality that I have allowed myself to gloss over in the light of that collective work. For example, another virtue of my

geological metaphor is that the erosion of determinism took place at markedly different rates on different terrains. Not uncommonly the least deterministic of disciplines most fiercely resisted indeterminism – economics is typical. This phenomenon emerges from the individual studies of the research group, and is further emphasized in a recent summing up of some of its results.[14]

I have mentioned a number of more specific topics on which I have only touched, or have entirely avoided: making up people; styles of reasoning; great scientists; philosophers; mathematical probability. There is a more glaring omission. I write of the taming of chance, that is, of the way in which apparently chance or irregular events have been brought under the control of natural or social law. The world became not more chancy, but far less so. Chance, which was once the superstition of the vulgar, became the centrepiece of natural and social science, or so genteel and rational people are led to believe. But how can chance ever be tamed? Parallel to the taming of chance of which I speak, there arose a self-conscious conception of pure irregularity, of something wilder than the kinds of chance that had been excluded by the Age of Reason. It harked back, in part, to something ancient or vestigial. It also looked into the future, to new, and often darker, visions of the person than any that I discuss below. Its most passionate spokesman was Nietzsche. Its most subtle and many-layered expression was Mallarmé's poem, 'Un Coup de dés'.[15] That graphic work, whose words are more displayed than printed, began by stating that we 'NEVER ... will annul chance'. The images are of shipwreck, of a pilot whose exact mathematical navigation comes to naught. But the final page is a picture of the heavens, with the word 'constellation' at its centre. The last words are, 'Une pensée émet un coup de dés', words that speak of the poem itself and which, although they do not imagine taming chance, try to transcend it.

2

The doctrine of necessity

In 1892 the iconoclastic American philosopher C.S. Peirce proposed 'to examine the common belief that every single fact in the universe is determined by law'.[1] 'The proposition in question' – he called it the doctrine of necessity – 'is that the state of things existing at any time, together with certain immutable laws, completely determines the state of things at every other time.' His examination was venomous. At the end: 'I believe I have thus subjected to fair examination all the important reasons for adhering to the theory of universal necessity, and shown their nullity.'[2] That was only the negative beginning. Peirce positively asserted that the world is irreducibly chancy. The apparently universal laws that are the glory of the natural sciences are a by-product of the workings of chance.

Peirce was riding the crest of an antideterminist wave. As is so often the case with someone who is speaking for his time, he thought himself alone. 'The doctrine of necessity has never been in so great a vogue as now.' He did warn against supposing 'that this is a doctrine accepted everywhere and at all times by all rational men.' Nevertheless he had to peer back into the distant past to find people with whom he agreed. The philosophy of Epicurus and the swerving atoms of Lucretius were, in his opinion, precursors of the statistical mechanics of Maxwell, Boltzmann and Gibbs. He had more allies than he imagined, but he was right in thinking that his examination of the doctrine of necessity would have been unthinkable in the eighteenth century.

For a before-and-after portrait, we inevitably contrast Peirce with the greatest of probability mathematicians, Laplace, author of the classic statement of necessity. 'All events, even those which on account of their insignificance do not seem to follow the great laws of nature, are a result of it just as necessarily as the revolutions of the sun'.[3] With those words Laplace opened his *Philosophical Essay on Probabilities*, a text that goes back to his introductory lectures at the Ecole Polytechnique in 1795.[4] It was full of memorable passages like this:

> Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it – an intelligence sufficiently vast to submit these data to analysis – it would

embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes.[5]

Philosophers were in complete agreement with the great physicist. In his *Foundations of the Metaphysics of Morals* Kant took as a commonplace that it is 'necessary that everything that happens should be inexorably determined by natural laws'.[6] Free will became a pressing problem because of the conflict between necessity and human responsibility. One resolution broadly followed the thought of Descartes, who had supposed there are two essentially distinct substances, mind and body, or thinking substance as opposed to spatially extended substance. Everything that happens to spatial substance is inexorably determined by law. Hence all spatio-temporal phenomena are necessarily determined. That might leave room for human freedom, so long as it is mental. Kant's account of human autonomy was a sophisticated version of this. The two substances, spatial and mental, were replaced by two worlds, one knowable, one not. The free self dwells in an unknowable realm of noumena. Kant was so convinced a necessitarian that he had to devise an entire other universe in which free will could play its part. Even that world did not escape universality, the concomitant of necessity in the phenomenal realm: the only principles that could govern rational beings must themselves be universal, just like the laws of nature.

What role could chance have in the deterministic world of phenomena? There had always been plenty of suggestions. There was the long-standing idea of intersecting causal lines. Suppose that you and I meet 'by chance' at the market. There may be a causal story of why I am at the market at ten past nine in the morning, choosing cantaloupes. A different but equally causal account will explain why you are there at that time, picking your peaches. Because the two sets of causes together entail that we will cross paths at 9.10, there was nothing 'undetermined' about our meeting. We call it chance, but not because the event was uncaused. Chance is a mere seeming, the result of intersecting causal lines. This face-saving, necessity-saving idea has been proposed again and again, by Aristotle, by Aquinas, and by the nineteenth-century probabilist A.A. Cournot, for example.[7]

Probability textbooks were less philosophically subtle but they too posed no threat to necessity. Prior to Laplace the best one was Abraham De Moivre's *The Doctrine of Chances*. It went through three editions, in 1711, 1738 and 1756. De Moivre's fundamental chances were equipossible outcomes on some sort of physical set-up. Everything that happened was itself determined by physical properties of the set-up, even if we did not know them. Any other idea of chance is wicked:

fissures and the crevices found in the rock of physical law, but it found no place in living matter until vitalism had been largely discredited.

This is not to say that the erosion of determinism had nothing to do with life. It had everything to do with life: living people. Not living people regarded as vital organic unities, but rather regarded as social atoms subject to social laws. These laws turn out to be statistical in character. They could be seen as statistical only when there were, literally, statistics. There could be statistics only when people wanted to count themselves and had the means to do so.

Let us then turn to counting. First I shall take up the counting that existed during the lifespan of Hume and Kant. It was largely of two kinds: secret and official, or public but amateur. The numbers disseminated by amateurs, when combined with available public records, were sufficient for an alert observer like Kant. Just as he finished *The Foundations of the Metaphysics of Morals* (with its noumenal account of the will) he received the first part of Herder's book on the idea of history.[16] He put that together with current reading of popular German statistics, and wrote a small essay on the idea of universal history. It began:

> Whatsoever difference there may be in our notions of the *freedom of will* metaphysically considered, it is evident that the manifestations of this will, viz. human actions, are as much under the control of universal laws of nature as any other physical phenomena. It is the province of History to narrate these manifestations; and, let their causes be ever so secret, we know that History, simply by taking its station at a distance and contemplating the agency of the human will upon a large scale, aims at unfolding to our view a regular stream of tendency in the great succession of events – so that the very same course of incidents which, taken separately and individually, would have seemed perplexed, incoherent, and lawless, yet viewed in their connection and as the actions of the human *species* and not of independent beings, never fail to discover a steady and continuous, though slow, development of certain great predispositions in our nature. Thus, for instance, deaths, births, and marriages, considering how much they are separately dependent on the freedom of the human will, should seem to be subject to no law according to which any calculation could be made beforehand of their amount: and yet the yearly registers of these events in great countries prove that they go on with as much conformity to the laws of nature as the oscillations of the weather.[17]

3

Public amateurs, secret bureaucrats

> *Trento, 11 September 1786* I console myself with the thought that, in our statistically minded times, all this has probably already been printed in books which one can consult if the need arises.
> *Edinburgh, 1 January 1798* Many people were at first surprised at my using the words, *Statistics* and *Statistical* ... In the course of a very extensive tour, through the northern parts of Europe, which I happened to take in 1786, I found that in Germany they were engaged in a species of political inquiry to which they had given the name of *Statistics*. By statistical is meant in Germany an inquiry for the purpose of ascertaining the political strength of a country, or questions concerning matters of state; whereas the idea I annexed to the term is an inquiry into the state of a country, for the purpose of ascertaining *the quantum of happiness enjoyed by its inhabitants and the means of it future improvement*.*[1]

Every state, happy or unhappy, was statistical in its own way. The Italian cities, inventors of the modern conception of the state, made elaborate statistical inquiries and reports well before anyone else in Europe. Sweden organized its pastors to accumulate the world's best data on births and deaths. France, nation of physiocrats and probabilists, created a bureaucracy during the Napoleonic era which at the top was dedicated to innovative statistical investigations, but which in the provinces more often perpetuated pre-revolutionary structures and classifications. The English inaugurated 'political arithmetic' in 1662 when John Graunt drew demographic inferences from the century old weekly Bills of Mortality for the City of London. England was the homeland of insurance for shipping and trade. It originated many other sorts of provisions guarding against contingencies of life or illness, yet its numerical data were a free enterprise hodge-podge of genius and bumbledom.

Visionaries, accountants and generals have planned censuses in many times and places. Those of the Italian city-states now provide historians

* Goethe at the start of his *Italian Journey*. Sir John Sinclair at the completion of his *Statistical Account of Scotland*. Goethe and Sinclair were travelling at almost exactly the same time.

with a rich texture of information. In the modern era, however, a census was an affair more of colonies than of homelands. The Spanish had a census of Peru in 1548, and of their North American possessions in 1576. Virginia had censuses in 1642–5 and a decade later. Regular repeated modern censuses were perhaps first held in Acadie and Canada (now the provinces of Nova Scotia and Québec) in the 1660s. Colbert, the French minister of finance, had instructed all his regions to do this, but only New France came through systematically and on time. Ireland was completely surveyed for land, buildings, people and cattle under the directorship of William Petty, in order to facilitate the rape of that nation by the English in 1679. The sugar islands of the Caribbean reported populations and exports to their French, Spanish or English overlords. New York made a census in 1698, Connecticut in 1756, Massachusetts in 1764. The United States wrote the demand for a decennial census into the first article of their Constitution, thus continuing colonial practice, and even extending it, as westward the course of empire took its way, across the continent and in due course to the Philippines. Going east, the British took the same pains to count their subject peoples. India evolved one of the great statistical bureaucracies, and later became a major centre for theoretical as well as practical statistics.

Thus there is a story to be told about each national and colonial development, and each has its own flavour. For example the first Canadian enumerations were possible and exact because the people were few and frozen-in during midwinter when the census was taken. There was also a more pressing concern than in any of the regions of mainland France, for whereas the population of British North America was burgeoning, the number of fecund French families in Canada was small due to the lack of young women. To take a quite different concern, the 1776 Articles of Confederation of the United States called for a census to apportion war costs, and the subsequent Constitution ordered a census every ten years to assure equal representation of families (as a sop to the southern plantations, blacks were to be enumerated as $\frac{3}{5}$ of a person). Six and seven decades later, those who interpreted the Constitution strictly insisted that a census could ask no question not immediately connected with representation.

No one will doubt that each region, once it takes counting seriously, becomes statistical in its own way. Stronger theses wait in the wings. For example, the nineteenth century statistics of each state testify to its problems, sores and gnawing cankers. France was obsessed with degeneracy, its interpretation of the declining birth rate.[2] The great crisis in the United States Census occurred after 1840, when it was made to appear that the North was full of mad blacks, while in the South blacks were sane and

healthy – strong proof of what was good for them.[3] Chapter 22 below is entitled 'A chapter from Prussian statistics', a phrase taken from a pamphlet of 1880. It is about antisemitism.

A survey of even one set of national statistics would be either superficial or vast. In either case it would provide excessive preparation for a reading of nineteenth-century counting. But for fear that we become fixated upon the avalanche of printed numbers that occurred after 1820 or so, I shall start with one regional example from an earlier period. I ended the last chapter by quoting Kant, writing in 1784. He wrote of the yearly registers of deaths, births and marriages which go in 'conformity to the laws of nature'. I began the present chapter quoting Goethe, who in 1786 spoke of 'our statistically minded times'. I shall use the German-speaking world, especially Prussia, as my example of those times. Graunt and the English began the public use of statistics. Peoples of the Italian peninsula and elsewhere had promulgated the modern notion of the state. But it was German thinkers and statesmen who brought to full consciousness the idea that the nation-state is essentially characterized by its statistics, and therefore demands a statistical office in order to define itself and its power.

Leibniz, my favourite witness to the emergence of probability in the seventeenth century, was the philosophical godfather of Prussian official statistics. His essential premises were: that a Prussian state should be brought into existence, that the true measure of the power of a state is its population, and that the state should have a central statistical office in order to know its power. Hence a new Prussian state must begin by founding a bureau of statistics.

He formulated this idea of a central statistical office about 1685, a few years after William Petty had made the same recommendation for England.[4] Leibniz saw a central office as serving the different branches of administration: military, civil, mining, forestry and police. It would maintain a central register of deaths, baptisms and marriages. With that one could estimate the population, and hence measure the power of a state. A complete enumeration was not yet deemed to be practicable. The population of a country, as opposed to a walled city or a colony, was in those days not a measurable quantity. Only institutions could make it one.

Leibniz had a lively interest in statistical questions of all sorts, and pursued an active correspondence on issues of disease, death and population. He proposed a 56-category evaluation of a state, which would include the number of people by sex, social status, the number of able-bodied men who might bear weapons, the number of marriageable women, the population density and age distribution, child mortality, life

expectancy, distribution of diseases and causes of death.[5] Like so many of Leibniz's schemes, such a tabulation was futurology that has long since become routine fact.

Leibniz brought these strands together in a memorandum of 17 August 1700. Prince Frederick of Prussia wanted to be king of a united Brandenburg and Prussia, and Leibniz urged his case. The argument is heavy with the future. A kingdom must be a viable unit, and its heartland must be its most powerful part. The true measure of strength is the number of people, for where there are people, there are resources for sustaining the population and making it productive. It had been contended by Frederick's opponents that Prussia could provide only a small portion of the power of a proposed Brandenburg-Prussia, and hence that the ruler should not be Prussian. That, countered Leibniz, was an error. According to the Prussian registers of births (commenced in 1683) 65,400 people were born every year in the entire region, 22,680 in Prussia. Hence Prussia was vital. Leibniz then used a multiplier of 30 to deduce that Brandenburg-Prussia had 1,962,000 inhabitants, or roughly two million. Even England, rich in people, could claim only five and a half million inhabitants.[6]

Leibniz wrote this advice in 1700. The kingdom of Brandenburg-Prussia was created next year, but, as one historian of Prussian statistics put it, with a royal court, but no state.[7] Certainly there was no statistical office. Prussian enumerations began only with the reign of Friedrich Wilhelm I, 1713–1740, famed for administrative skills and controlled militarism. His agents had first to figure out how to count, for available numbers were far less reliable than Leibniz's rhetoric had made it appear.

Reorganization was undertaken piecemeal, starting with a machinery for registering births, deaths and marriages in the four (royal) residence cities of Brandenburg-Prussia. In 1719 an abortive enumeration of the entire state was attempted. Various systems of reporting were experimented with, and an initial summary of results was issued on 3 March 1723. By 1730 people were officially sorted into the following nine categories: landlords, goodwives, male and female children; then household members classified as journeymen, farmhands, servants, youths and maids. The rubrics endured but the subclassifications exploded. Workmen became classified according to 24 occupations, and special categories were created for the chief industry: cloth makers, fabric makers, hat makers, stocking makers etc. Quantities of worked wool were fitted into the tables. Buildings were meticulously sorted (roofed with tile or straw, new or repaired, barns or decaying), and cattle, land and roads were described. For what purpose? Often, of course, for tax-

focussed on the body, on 'biological processes: propagation, births and mortality, the level of health, life expectancy and longevity'. Foucault regarded these as 'two poles of development, linked together by a whole intermediary cluster of relations'. The distinction between the body politic and the body of the person sounds fine, but in fact I don't see Foucault's polarization in the texts that concern us. Süssmilch's statistical assessments (the biopolitical pole) are directed exactly at propagation, births, mortality, health, life expectancy (the anatomopolitical pole). But no matter how we take Foucault's polarization, biopolitics in some form has been rampant in western civilization from the eighteenth century or earlier.

The most famous piece of biopolitics is the Malthusian debate. This originated well before Malthus published in 1798, as his subtitle made plain: *With Remarks on the Speculations of Mr Godwin, M. Condorcet and Other Writers*. His celebrated proof, that production increases arithmetically while population grows geometrically, did, however, introduce a nineteenth-century preoccupation. His conclusion was that the poor must, at their own peril, have few children. Karl Pearson's eugenics presented the same theme at the start of our century, not in order to help the poor but to save the rich.

Biopolitics has the standard feature of a risk portfolio, namely that at almost the same time opposite extremes are presented as dire perils (today it is nuclear winter/greenhouse effect).[18] The 'population problem' denotes both the population explosion of other peoples and too low a birth rate of one's own people. During the nineteenth century in France, one's own people were French, the others German and British. In Prussia, as discussed in chapter 22, the others were Jewish. Today the others are the Third World. In late-Victorian England, the others were the labouring classes.

German biopolitics began in earnest after the Seven Years' War in 1757–63, and here the issue was underpopulation. Perhaps a third of the people had died, and many regions were left almost empty. They required colonization in order to restore ravished farmland. Many features of Prussian statistics originate with this objective concern, augmented by the zealous administration-for-its-own-sake of Frederick the Great.

A list of the categories of things that were counted during his reign required seven pages.[19] Many were 'natural', to be expected in any agricultural state whose economic development was comparable to Prussia's. But there were idiosyncrasies. First, a fundamental distinction was imposed upon the population. Every person had to be either civil or military. The military included not only the soldiers, but also their dependants and servants. The civil list was sorted according to the nine rubrics mentioned above: the military list had five divisions. This sorting

was enduring. When we examine the excellent yearbooks published by the Prussian statistical bureau throughout the latter half of the nineteenth century we find the first division in the population: military on the left, civil on the right. You were first of all civil or military, then you were male or female, servant or master, Mennonite or Old Catholic. There was of course an unstated rationale. People were counted, as they still are, by geographic area. The civilian population stayed in one place, while the military were mobile and in garrisons. Military and civil were different aspects of the national topography. But in all of Europe, it was only Prussian official statistics that saw this as a first principle of all labelling of citizens, more fundamental, even, than their gender.

A second innovation began in 1745, probably in response to queries posed in the first edition of Süssmilch's book. We find the beginnings of tables for immigration, emigration, nationality and race. On the civilian side of the list, the nine basic categories had a subtabulation for people who were Walloons, French, Bohemians, Salzburgers or Jews. Although East Prussia was part of the kingdom, Poles, Lithuanians, Latvians etc. were not mentioned. This was partly because East Prussia was indifferently administered, and partly because it was not contiguous with Prussia proper so that migration between these two parts was less easy than between the other Prussian 'islands' in the west. Specific migration questions developed piecemeal. The Silesian towns began to record bourgeois movements from 1750. Some tables of colonists were made in 1753, but they became serious only during the reconstruction period following 1763. They started in Minden in 1768, and soon the tables covered the entire kingdom.

Most designations of minority groups were local and haphazard, the exception being Jews. They show up in the tables in 1745, and, at that time, not as a religious group. Soon there was to be a completely separate and regular enumeration of all Jewish households. Complete tables, known as the *General-Judentabellen* or *Provinzial-Judenfamilie-Listen*, became a routine part of Prussian numbers in 1769.

Aside from the tables of births, marriages and deaths, official statistics were private, for the eye of the king and his administrators. There were of course all kinds of documentation in commercial affairs, although even these tended to follow the patterns of counting people.[20] They ran parallel to the diligent productions of enthusiastic amateurs, of whom Süssmilch and Busching provide two different kinds of example. The third force in German statistical activity was the 'university statistics' from which our subject is said to take its name.

It is unclear (and unimportant) how far back the tradition of university statistics can be traced. Herman Conring, the great Jena professor of

politics and geography – and correspondent on these topics with Leibniz – is said to have given enthralling lectures on the economic states of various nations, and is often properly called the founder of the 'university statistics'. He called his lectures *notitia statuum Germaniae*. A successor in Jena, B.G. Struve, lectured on *de statu regni germanici*, and then, *notitia statuum Germaniae*. Martin Schmeitzel at the same university had a *Collegium politico-statisticum* in 1725.[21]

Words on which our word 'statistics' could draw are hardly original with these professors, and probably have a better Italian pedigree than a German one. But it was undoubtedly a Göttingen scholar who fixed the very word 'Statistik'. Gottfried Achenwall thought of what he called statistics as the collection of 'remarkable facts about the state'.[22] The successor to his chair valiantly defined statistics in the words, 'History is ongoing statistics, statistics is stationary history.' The Göttingen statisticians had a strong positivist bent:

> Strictly speaking, one wants only facts from the statistician; he is not responsible for explaining causes and effects. However, he must often seize upon effects in order to show that his fact is statistically important – and moreover his work will be entirely dry, if he does not give it some life and interest by introducing, at suitable points, a mixture of history, cause and effect.[23]

The work of these men was seldom quantitative. They were opposed to number-crunching of the sort represented by Süssmilch. They thereby stand for an antinumerical and anti-averaging tradition that emerges from time to time in our history. They produced giant pull-out tables, but here one found descriptions of climates (for example) more often than measures of cloudiness. Despite this, I find a very substantial continuum between the historical-political-economic-geographic-topographical-meteorological-military surveys of the university statisticians, and, for example, the contents of Busching's two journals. Busching was thoroughly numerical – statistical in our sense of the word – but on the title pages or in the titles of many of his books he called himself an historian-geographer – a statistician in the Achenwallian sense of the word.

German culture demands definitions of concept and object. It requires an answer to the question: is X an (objective) science? Is statistics, then, a science? If so, what science is it, and what are its concepts, what its objects? 'Until now, there have been 62 different definitions of statistics. Mine will make it 63', wrote Gustav Rumelin in 1863.[24] He was director of the Württemberg statistical office, a political scientist and staunch Malthusian. I don't know which 62 he had in mind – I think that by 1863 I can do twice as well as he can, in the German literature alone. But already there had been the correct move taught by professors of philosophy: distinguish! There are two sciences. One is descriptive and non-numerical, namely the

work of the university statisticians. Then there is the heir to English political arithmetic, commenced seriously in Germany by Süssmilch. C.G.A. Knies's 1850 *Statistik als selbständige Wissenschaft* furthered this conclusion, recommending that although we owe the word 'statistics' to Achenwall, we should transfer it, and use it to name the numerical studies of the political arithmeticians.[25] We ought then to say that Achenwall did something other than *Statistik*; let us call it (said Knies) *Staatskunde*.

So what? All this seems like word-play. Harald Westergaard ironically recounted this 'saga' of the word 'statistics', concluding that 'but for the curious change of names which has taken place, and which has often puzzled students of statistics, little interest would have attached to it'.[26] Westergaard implied that we would never even notice Achenwall were it not for his having institutionalized the word 'statistics' which we now use to name something numerical and non-Achenwallian.

Perhaps that opinion underestimates the university statisticians. For example, Austria established a statistical office, on the Prussian model, only in 1829. This was a systematic bureaucracy for the compilation of numerical data. Who would it employ? The staff was taken straight from the universities, where old-style university statistics continued to be taught. The subject was part of the curriculum at the six Austrian universities – Innsbruck, Padua, Pest, Prague, Venice and Vienna. It was also standard at numerous colleges and lycées. Rightly or wrongly, the Austrian administrators did not see teachers and students as doing something essentially different from what a statistical bureau should do.

The Austrian example is an objective item from bureaucratic history. At a more impressionistic level it looks as if the Prussian statistical bureaucracy was remarkably continuous with the old university statisticians. It was numerical, yes, but also descriptive. There was a great deal of resistance to theoretical French notions of 'statistical law'. The Prussian tabulations resembled those of Achenwall and Schlozer, although with numbers instead of words. Bureaucratic efficiency was combined with mathematical naiveté. The Prussian bureau was heir to university statisticians, just as it was heir to the administrative expertise of the ministries of Frederick the Great, and heir to the army of amateurs of numbers.

It was however the amateurs of numbers that most struck literary travellers such as Goethe and Bernoulli. The travel books constantly referred to local periodicals more ephemeral than Busching's, crammed with numerical tid-bits, collected with an indiscriminate enthusiasm not equalled in Britain or France. Travellers with an eye to policy and public affairs could also learn. None toured more diligently in the continent of Europe than gentlemen from the British Isles. Arthur Young's travels in Europe, and his subsequent role in agricultural reform, are well known.

But such travellers did not import only agricultural technique. As we have seen from my second epigraph, they acquired an enthusiasm for statistics. The very word entered English by way of one of the greatest of the Scottish agricultural reformers, Sir John Sinclair. He was the author-editor of the stupendous 21-volume *Statistical Account of Scotland*, the result of compendious answers to mighty questionnaires. The respondents were the ministers of the 938 parishes of the Church of Scotland.*[27] Sinclair set about this project only after his German travels. His German lessons were not confined to Scotland, however. Here is a laconic diarist of the London scene:

> *August 20th, 1793*: Farmer George has left his harvests and come to town – not to gape at the sights but to make his voice heard in high places – Sir John Sinclair, a Scottish laird, and a group of other large landowners, have induced Mr. Pitt to form a Board of Agriculture. Arthur Young, editor of the *Annals of Agriculture*, has been appointed secretary ... its first duty, I hear, will be to collect the agricultural statistics of the country, based upon returns from every parish.[28]

* The *Account* does provide much information that we would still call statistical, for example an analysis of the age distribution, life expectancy and estimates of the total population and its rate of change. There is also much information about lifestyles, for example the fishwives of Fisherow in Inveresk who carry 200-pound baskets of fish on their backs to the Edinburgh market, often covering the five miles in less than an hour, women who take the dominant role in their family and the community, swear much, but, according to their minister, otherwise sin seldom, who play golf on Sundays and have football matches between the married and unmarried women, the former of whom invariably win.

ment, but it was also the 'natural' thing to do. A central bureau dedicated to the pure science of numbering for its own sake: that would be an anomaly.

Prussia inaugurated the anomaly that became the wave of the future. It is tempting to describe the Prussian statistical bureau as an office of numbers-in-general. The bureau was a resource for all the other branches of government. Such an institution presupposes that there is a special type of knowledge, and a new kind of skill, the ability to collect, organize and digest numerical information about any subject whatsoever. That skill will present itself as neutral between parties, as independent of values, as objective.

We do not here want a history of institutions like the Board of Agriculture in London or the Royal Statistical Bureau in Berlin. We need notice only that new kinds of authorities were created, with new kinds of mandate. The transition was commonly effected by coopting the talents of the amateurs. Prussia provides the purest example of synthesizing the talents of secret governmental eighteenth century collectors of information with those of the fetishistic amateur enthusiasts of numbers. One man well represents the combination. Leopold Krug began as one of the greatest of the amateur geographer-statisticians, and became one of the first of the new breed of officially appointed numerators who made public digests of almost all that they counted. Krug had neither the wealth nor the status of a Sinclair. He could not found an organization; he could only accept a call. When the official, secretive bureaucracy was floundering he was an amateur ready to step in to change its methods and aims.

In honour of the coronation of Friedrich Wilhelm II, there was proposed in 1787 a new enumeration of the Prussian people and their dwellings. The motivation was explicit: let the new king and his ministers be told of their power. Unfortunately this was a time of national mismanagement and fading authority. Prussia looked grand on the map, having vastly expanded in the east thanks to successive annexations of parts of Poland. By the third partition of Poland in 1795, Prussia had doubled in size. Yet in that same year it relinquished to revolutionary France, with curious indifference, the prosperous German-speaking lands west of the Rhine. So it was trying to absorb an impoverished, alien and alienated people while losing a good number of its literate artisans. Frederick the Great's erstwhile freedom of the press and religion were terminated, but order diminished and effective control became rare. The bureaucracy seemed unable to achieve even minor goals. In particular, it could not enumerate its own heartland, let alone its disaffected subjects in East Prussia. The secretive bureaucrats had very little information about

which to be secretive. Matters were left to the amateurs, among whom none was more notable than Krug.

He had been trained at Halle as a theologian but soon devoted his energies to describing the nation. Between 1796 and 1803 he produced a thirteen-volume *Topographical-Statistical-Geographical Dictionary of the entire Prussian State*, which provided a summary of people and production from every village in the realm.[6] He had the usual battle of an amateur with the censors. In 1796, in conjunction with his dictionary, he began his own journal, which was immediately censored for its article on 'Prussian Military Organization'.*[7] But on the death of Friedrich Wilhelm II he was given a post in the finance department, possibly because of the attention that his banned essay had attracted.[8] This post gave him access to more information than the previous generations of amateurs. He put it to good use. His labours culminated in two remarkable volumes called *Observations on the National Wealth of Prussia*.[9] This was a marvellous condensed model of what could be told by numbers-in-general about every locale in the kingdom. It moved the king to issue a decree on 28 May 1805:

> A bureau shall be established to collect and integrate statistical tables from the different departments and offices, the special directories, and from the Silesian finance ministry. His majesty decrees that this department shall be administered by councillor Krug, with direct responsibility to Minister of State Stein.[10]

Stein himself wanted some sort of statistical office, but not one run by an amateur.[11] He had a keen eye on the innovations of France under the emperor, and knew that the time for numbers had come. But he wanted ministries run on a firm but traditional line. Statistics should be retained in a standard ministry directed by a standard official. He had his own favourite from Finance for the job. Krug, he told his king, had neither the status nor the ability to handle complex state affairs. The king was unmoved. I have quoted part of his reply at the head of this chapter, to the effect that we don't want brilliance, we want German diligence. The resulting brief compromise between Stein and the king collapsed with everything else when Napoleon's armies triumphed at Jena in 1807.

Stein, engineering the reconstruction of the shattered Prussian state, knew that statistics would have to play a part. But how? In a circular letter to provincial administrators he invited proposals for a new statistical

* Krug's enthusiasm for publication was hard to dampen. In 1804 he teamed up with L.H. Jakob, a philosophy professor at his old university, Halle, to found another periodical. Jakob wrote extensively on immortality, ethics, God, as well as intervening in or maybe inventing a controversy between Moses Mendelssohn and Kant. His true love was finance, and he proposed a new science of national economy that was to be furthered by the new periodical. Jena was more effective than mere censorship: Napoleon abolished the university at Halle. Professor Jakob went off to St Petersburg to advise the imperial government and to found his new science.

office. The response from Königsberg attracted his attention. One of its citizens, J.G. Hoffmann, a man armed with numerous diplomas but of no fixed profession, had been assigned the job of reporting to Berlin. His remarks on Krug's work were derisive. Had Krug given ample information on crops in all the regions of Prussia? Farmers, said Hoffmann, always lie to evade taxes: Krug's figures were 'thoroughly false and consequently thoroughly useless'.[12]

Hoffmann wrote to Stein's taste. His immediate reward from his own city was a chair at Königsberg.[13] He drew up an elaborate reasoned structure for numbering, based on six main categories and 625 subcategories. He stated an official rationale for a central statistical office which became incorporated into a memo from Dohna, the minister of the interior, to the interim chancellor, Altenstein:

> The Bureau shall have as its purpose the most complete collection possible of material bearing on the Prussian state ... the power of the state lies partly in its territory, partly in its people ... the one provides the raw material, and the other by capital and labour transforms it ... Hence the collection of data naturally falls under two main heads, one geographical and one anthropological. It is then natural to appoint two officers, one for each branch ... but the work of these two collectors, no matter how extensive, can be used only with difficulty, unless we appoint a third officer over these two, an officer armed with the necessary skills and tools to engage in political arithmetic in the most general sense of the words. He will transform the material of the first two officers so that they can be put to immediate use by the highest administrators in the land.[14]

The third man was to be a new kind of bureaucrat, doing a new kind of job. Dohna nominated Krug for anthropologist, student of people, as well as proposing a geographer, and a mathematician for the new political-arithmetical task of digesting information. Altenstein cared for Krug's type of person no more than did Stein. 'I don't fail to recognize the diligence and loyalty with which he has for so many years toiled for the Prussian state, but it would not be right to assign him the role of an independently thinking worker ... He has far too narrow a conception of political economy.'[15] None of the individuals suggested by Dohna were suitable leaders. They should be regarded as mere 'tools'.

There was a lot of bickering back and forth. Although the disputes were local, personal, petty matters of power and patronage, they reflected a genuine malaise. What *is* a statistical office? What kind of task does it perform, and what kind of person directs it? Hoffmann was waiting in the wings. His civil service status as professor was higher than that of Krug's in the finance department. He negotiated a dual role as director of the new bureau of statistics and as professor of a new chair of political science in Berlin, where he would teach the theory of the new science that he

directed. The director maintained this role and source of income until 1860. Even then the new director, Ernst Engel, no longer *ex officio* a professor, established a famous 'statistical seminar' that trained most of the new generation of German economists of the 1860s.[16] Achenwallian university statistics was not abolished but transformed.

In the new administration Krug got the secondary, anthropological post. He had *de facto* control of the bureau during 1814–21, when Hoffmann was engaged in larger games, such as assisting Hardenburg at the Congress of Vienna. These details are trifling, in themselves only an accidental sequence of facts. But some such sequence had to embody the creation of the new kind of institution. What was being resolved on paper and in the disposition of persons was the very nature of a general all-purpose statistical office. Friedrich Wilhelm, in 1804, and Dohna, in 1809, saw it, albeit dimly, as a new type of organization with a new kind of worker providing a new kind of direction. The traditional and no-nonsense ministers Stein and Altenstein preferred something that fit into a streamlined version of the old order. They saw it as an organ to assist the finance ministry. The taxonomic tree of government had to be maintained, and an office that in principle might serve all ministries could not fit. Dohna and the king won. Prussia was being rebuilt from the foundations, and had a place for new institutions.

A man may float and make his way in a dual role. The formal position of Hoffmann, both director of the bureau and professor in Berlin, nicely signalled that the bureau was not part of an old order. But unlike a man, a government office cannot exist in free suspension; it must report to someone. It must have a place in the structure of administration. Since nobody, not even Hoffmann, knew what this new entity was, no one knew how to lodge it. In 1805 it had briefly reported to Stein, minister of state for trade. In 1810 it went to the *Polizei* of the ministry of the interior. In 1812 it was placed directly under the new and powerful chancellor, von Hardenburg. He kept it until 1823, when it went to the interior ministry. It stayed there until Hoffmann died at the age of 79, in 1844. Under the directorship of his successor C.F.W. Dieterici it moved to the ministry of commerce; on his death it reverted to the interior.

One characteristic feature of the new kind of bureau was little affected by its administrative home. It published and published and published, combining the eighteenth-century enthusiasm for making numbers public with the power of orderly government. It needed no Sinclairian letters in blood-red ink to get responses. Hoffmann himself, professor-bureaucrat, published over 300 statistical papers, as well as numerous monographs and official and semi-official handbooks. The numbers, then, were out for all who would read. A specific publication of the statistical office did not,

however, emerge during Hoffmann's long lifetime. That was left for his pupil and successor, Dieterici.[17] There was not, during the half-century 1810–60, a real dedication towards centralizing the publishing of numbers. Hoffmann's bureau was still gentlemanly and very much under a regime run by men whose ideas, however radical in their day, had been formed before 1810. The requisite new broom was Ernst Engel, brought in from Saxony. A man of energy, before he was 30 he had organized the first world trade fair at Leipzig (1850, the year before the Great Exhibition in London, and establishing Leipzig's tradition summed up in its motto today, *Die Messestadt*). He had established the Saxon statistical bureau, founded two statistical journals, invented mortgage insurance as a means to solving the housing problem, and so on. He started three new periodicals as soon as he was called to Berlin, and in one of them provided, with some dismay, a list of official government statistical periodicals current in 1860. These were regular publications, not occasional papers or special reports; they were published material, not in-house documents; these were not city or provincial papers, but ones issued by the central government in Berlin. It took him 21 pages to list the 410 periodical publications.[18] There were effectively none such in 1800. Is my phrase 'avalanche of printed numbers' an hyperbole?

One might think that an Engel, confronted by this ceaseless statistical activity, might want to call a halt. Not at all. He did indeed want to centralize the publication of statistical data, and moved swiftly to establish a Central Statistical Commission, to correlate the work of all other departments and ministries. Appointed on 1 April 1860, he presented the complete plans for the Commission to his minister on 24 June. But he wanted all the work done by the numerous national authorities replicated on the local scale. Every city, and in particular the free cities of Germany, should do in their domain what his office would do for the kingdom. Each of the 25 regional administrations of Prussia should do the same. The final goal would be that every district, every *Kreis*, every village, should have its own statistical office. This never did happen, but the pattern was there, each major city vying for its own statistical administration: Berlin 1862, Frankfurt-am-Main 1865, Hamburg 1866, Leipzig 1867; Lubeck, Breslau and Chemnitz 1871, Dresden 1874, and 27 major city offices by 1900. There was nothing peculiarly German about this; compare Vienna and Rome in the same year as Berlin, New York and Riga 1866, Stockholm 1868, Buda, 1869.

I shall lay great stress on the very first published civic statistics of a 'modern' sort, those begun by Paris and the Department of the Seine in the 1820s. I shall not even sketch that institutional history, noting only that every country was statistical in its own way. The history of Prussian

numbers that occurred throughout Europe. Without the post-war bureaucracies there would have been no tabulations in which to detect law-like regularity. But there also had to be readers of the right kind, honed to find laws of society akin to those laws of nature established by Newton. Prussia was and will remain our 'crucial experiment', the state with exquisite statistics and a resistance to the idea of statistical law.

What made the difference between France and England on the one hand, and Prussia on the other? I shall briefly mention a simplistic East/West contrast, made familiar by some historians of European culture, and then, in this chapter, point to a specific fact of French intellectual history.

East/West is gross but convenient. The dominant languages and institutions of the West were French and English, its capitals Paris and London. The chief language and institutions of the East were German, and Berlin increasingly became its centre of gravity. Mainline western thought was atomistic, individualistic and liberal. The eastern, in contrast, was holistic, collectivist and conservative.

The western sovereign, whether it be a king or the people, was constituted by the individuals in its domain, just as Hobbes had taught. Further east, as Herder's successors were to insist, the group – its civilization and language – conferred identity upon the individuals who comprised it. Western individuals (so ran their philosophy) constitute their sovereign. Eastern states (so said their philosophers) constitute the individuals.

The liberal West held that industrial society with all its problems and successes was best run by a combination of free individual competition and philanthropy. The conservative East created the welfare state. Berlin introduced workmen's compensation for industrial accidents, health and unemployment insurance, and other aspects of the social net. Many of the men who did the spadework for this Prussian collectivism worked in the bureaux that collected statistical data and resisted any idea of statistical law.

How far can one take this caricature of a contrast beyond the political arena? Norton Wise has pushed it as far as physics.[2] He urges a fundamental divide between western and eastern physics that endured throughout the nineteenth century, and which parallels the differences between liberals and conservatives. His analysis spans the entire field, but an example will suffice. Boltzmann and Maxwell converged on 'the same' statistical mechanics. They did so by substantially different routes. Maxwell was open to the idea that this science is indeterministic. Its laws might be purely probabilistic in character. Boltzmann, on the other hand, held deeply to a belief that statistical mechanics is deterministic. One of his chief results, the *H*-theorem, was intended to confirm this.

Obviously, not all easterners rejected the idea of statistical law, nor did all westerners think that there are statistical laws. It does however happen that the German advocates of statistical law were typically in the liberal minority, while those French and English opponents of the very idea were commonly in the conservative camp. I shall from time to time draw attention to notable examples.

It is misleading to say that the dominant Prussian reaction to the French idea of statistical law was to reject it. 'Law' itself was understood differently. Here is a judicious French observer, writing in the article *Loi* for *La Grande Encyclopédie* at the end of the nineteenth century.

> The English ... envisage law, in itself, as a given fact, and their reasoning implies that it is a product of the will of individuals. The Germans (historians and metaphysicians) attacked the problem [of law] at its origins ... they regard law as a social product, at the same level as custom and language; it is never fixed, but in constant evolution and transformation.

Why, if you are a conservative, who regards law as a social product, are you disinclined to think that statistical laws can be read into the printed tables of numerical data, or obtained from summaries of facts about individuals? Because laws are not the sort of thing to be inferred from individuals, already there and counted. Laws of society, if such there be, are facts about the culture, not distillations of individual behaviour.

Why, if you are a liberal who regards law (in the political sphere) as a product of the will of individuals, are you content to find statistical laws in facts about crime and conviction published by the ministry of justice? Because social laws are constituted by the acts of individuals.

This model indicates where many nineteenth-century incoherencies arise. To begin with, if, as many today will tell you, probabilistic law applies to populations, *ensembles*, or *Kollectivs*, ought not the collectivist, holistic attitude be the one that invites the notion of statistical law? Conversely, if the liberal thinks that statistical laws are laws of society, akin to laws of nature, then what freedom is left to the individuals en masse? This question of statistical fatalism reared its confusing head in mid-century.

The broad issues of statistical fatalism and East/West will occupy us much in the sequel. Here I turn to a more specific antecedent for the idea of statistical law. It was a pre-statistical, even antistatistical, notion of laws of society. It was a conception of the moral sciences. Daunou's declamation in my epigraph is a ringing statement of faith. The moral sciences are reasonable, liberating, and the foes of tyranny.

Science morale does not denote that priggish entity that we in English call morals. It is more to be understood as a science of *mœurs*, of customs, of society. In the course of effecting its mid-nineteenth-century reforms,

Selected by The Modern Library as one of the 100 most important non-fiction books published in English in the twentieth century, *The Taming of Chance* continues the author's enquiry into the origins and development of certain characteristic modes of contemporary thought undertaken in such previous works as the best-selling *The Emergence of Probability*. Professor Hacking shows how by the late nineteenth century it became possible to think of statistical patterns as explanatory in themselves, and to regard the work as not necessarily deterministic in character. In the same period the idea of human nature was displaced by a model of normal people with laws of dispersion. These two parallel transformations fed into each other, so that chance made the world seem less capricious: it was legitimated because it brought order out of chaos. Professor Hacking argues that these developments have led to a new style of scientific reasoning gaining its hold upon us. The greater the level of indeterminism in our conception of the world and of people, the more we expect control and intervention in our lives, and the less we expect freedom.

Combining detailed scientific historical research with characteristic philosophic breadth and verve, *The Taming of Chance* brings out the relations between philosophy, the physical sciences, mathematics and the development of social institutions, and provides a unique and authoritative analysis of the 'probabilisation' of the western world.

IAN HACKING is Professeur au Collège de France, Chaire de philosophie et histoire des concepts scientifiques, and University Professor, University of Toronto. He is Fellow of the Royal Society of Canada and Fellow of the British Academy, and Fellow of the American Academy of Arts and Sciences. He is the author of many books including *The Logic of Statistical Inference* (1965), *Why Does Language Matter to Philosophy?* (1975), *The Emergence of Probability* (1975), *Representing and Intervening* (1983), and *An Introduction to Probability and Inductive Logic* (2001).

Cover illustration: *The Dice Players* by Georges de la Tour (1593–1652). Reproduced by kind permission of Stockton-on-Tees Borough Council.

CAMBRIDGE
UNIVERSITY PRESS
www.cambridge.org

ISBN 0-521-38884-8

9 780521 388849